tarsus at all, nor any bones which we can with certainty call "metatarsal." We have only one single long bone, at the lower end of which are three or four articular surfaces for the three or four toes. The study of the very young bird, however, has shown us that though no tarsus can be distinguished in the adult, yet such a part does exist for a certain brief period of the bird's life and then disappears.

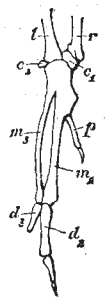

FIG. 10.—Right hand of Ostrich.—c^1, radial carpal ossicle; c^2, ulnar carpal ossicle; d^2, proximal phalanx of the index digit which has three phalanges; d^3, phalanx of third digit; l, ulna; m^2 and m^3, metacarpals of second and third digits anchylosed together and with that of the pollex; f^1, proximal phalanx of pollex; r, radius.

In its fate we have an interesting resemblance to the condition which we have already found existing in the crocodile, and which condition the bird exaggerates. The upper part of the tarsus becomes not merely firmly fixed to, but indistinguishably united with, the leg-bone, or tibia, while the lower part of the tarsus becomes as indistinguishably united with the coalesced metatarsals, and thus it comes about that no tarsus whatever is distinguishable in the adult. The apparent leg-bone (tibia) is leg-bone with part of the tarsus also; the apparent metatarsal bone is made up of metatarsal bones with the other part of the tarsus also. The movement of the foot on the leg takes place in the bird (as in the crocodile), not between the leg and ankle, but in the middle of the ankle itself.

In the skeleton of the bird's fore-limb, or wing, the hand is strangely different in aspect from the foot. There is hardly any carpus (or wrist) visible. The metacarpus is represented by a single complex bone formed of three metacarpals anchylosed together, and there are only three fingers, which are all more or less rudimentary.

Here serial symmetry is more disguised than ever in the bat, the difference between a bird's wing and a bird's leg being so great. And yet even here we meet with a curious example of the tendency to vary similarly which exists in serially homologous parts; for in the bird's carpus there is a similar arrangement, though less thoroughly carried out, to that which exists in the bird's tarsus. The distal part of the carpus coalesces altogether with the metacarpus (as the distal part of the tarsus does with the metacarpus), but the proximal part remains distinct in the form of two separate carpal bones.

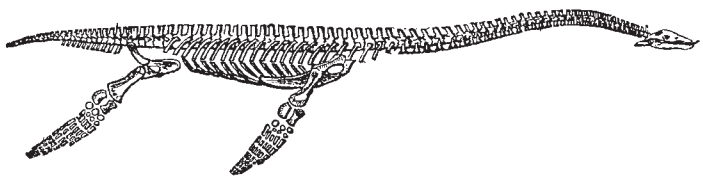

FIG. 13.—Skeleton of a Plesiosaurus.

(*To be continued*)

ST. GEORGE MIVART

THE OBSERVATORY OF PARIS

ARRANGEMENTS for the future management of the Observatory at Paris are now complete. Contre-Amiral (until recently Captain) Mouchez is appointed director, with M. Maurice Lœwy as sub-director—these appointments taking effect for five years.

M. Mouchez was born at Madrid in 1821, but is the son of French parents. He joined the Naval School at Brest in 1837, and in 1839 commenced his nautical career in the *Fortune*, which was taking part in the blockade of Buenos Ayres. In 1840 he was appointed to the *Favorite*, which proceeded on a circumnavigating expedition extending over five years. Having shown an early aptitude for astronomical observations, he was intrusted with them. On this voyage he became aware of the imperfect determination of the latitudes and longitudes of some of the sea-ports visited, and his attention was directed to the construction of portable instruments for improving them. In 1850 he embarked on board the *Capricieuse*, also destined for a scientific voyage round the world, which, like that of the *Favorite*, occupied five years. He was charged by the Dépôt de la Marine with the survey of the Rio de la Plata and the Brazils, a survey which extended over about 3,000 miles.

In 1860 M. Mouchez was commissioned by the French Government to visit England, for the purpose of reporting upon the system of weather predictions organised by the late Admiral Fitzroy, Leverrier at the time contemplating the establishment in France of his own system of storm-warnings. M. Mouchez, who was enthusiastic in favour of the Fitzroy arrangements, suggested that the *Dépêche anglaise* should be posted in the French ports, and recommended a special meteorological organisation independent of the Observatory at Paris. The proposition, which was carried into effect, is said to have created differences between Leverrier and the Minister of Marine. M. Mouchez greatly interested himself from an early period in his naval career in promoting astronomical and physical studies amongst the officers of the Government marine, and observations while at sea. His views are noticed by Arago in his introductory work for scientific travellers.

In 1867 he commenced the survey of the coast of Algeria, a work which, in consequence of repeated interruptions from his employment on other urgent missions, was not completed until 1877. Thus in 1870, Contre-Amiral Mouchez was sent with the French fleet to the Baltic for the blockade of the Prussian coasts, but the attempted blockade proving a failure, he was recalled and charged with the defence of Havre, which place he succeeded in preserving from a threatened hostile occupation.

In 1874 he was sent to the Island of St. Paul for the observation of the transit of Venus, and next to that of M. Janssen his mission may be considered the most successful. At his suggestion the French Government established, in 1875, an observatory at Montsouris, where naval officers are practised in making astronomical observations, as also intending travellers, on the recommendation of the Société de Geographie. He is a member of the Academy of Sciences in the section of Astronomy,

and of the Bureau des Longitudes, and was for some time a member of the Council of the Observatory. It is understood that M. Bardoux suggested the adoption of the system in operation at the United States Naval Observatory at Washington, and to model the great Paris Observatory after that institution; and as stated above, the appointment of Admiral Mouchez as director, and M. Lœwy as sub-director, are at present intended to be limited to five years, with the same restriction as to future nominations.

M. Maurice Lœwy, who was born at Pesth in 1834, commenced his astronomical career at the Imperial Observatory of Vienna, under the late Prof. Carl von Littrow, on whose recommendation he was transferred to the Observatory of Paris by Leverrier, in 1860. At Vienna he was much occupied with the calculation of the orbits of comets, including the great comet of Donati in 1858, for which body he was one of the first to establish elliptical elements. He succeeded Laugier, as one of the astronomers of the Bureau des Longitudes in 1872, and since 1874 has been charged with the preparation of the *Connaissance des Temps*, the French national ephemeris, and the *Annuaire*, works which have greatly benefited by his energetic superintendence. Under Delaunay's rule, M. Lœwy occupied the position of sub-director of the Observatory of Paris, charging himself with the meridian observations.

The installation of Admiral Mouchez took place on Saturday by the Council of the Observatory, of which M. Dumas is president.

PROF. W. M. GABB

WE greatly regret to hear of the death from consumption, on May 30, at his residence in Philadelphia, of Prof. William M. Gabb, who for many years has occupied a very prominent place among American naturalists.

He was born on January 20, 1839, in Philadelphia, and was educated at its High School, being one of the many graduates of whom that institution had reason to be proud. As a boy he was especially interested in mineralogy and palæontology, and at an early age was so fortunate as to secure an engagement with Prof. James Hall, where he had ample opportunity of indulging his tastes. Returning to Philadelphia, he became a member of the Academy of Natural Sciences, and soon commenced the critical study of the fossil invertebrates of the United States, especially those of the cretaceous formation.

In 1860 he entered the service of the Geological Survey of California, under Prof. J. D. Whitney, but returned to the East in 1868, and undertook the geological survey of their lands for the Santo Domingo Land and Mining Company, which, however, was made to cover a considerable portion of the Dominican Republic, and to which he subsequently made several successive visits for the purpose of continuing his work.

During his connection with the Geological Survey of California he made an extended exploration of the peninsula of Lower California, collecting much important geological and biological material.

In 1873 he became connected with the Costa Rican Government, undertaking a general geological and topographical survey of its territory, and combined with it very extensive researches into its natural history and ethnology, sending his collections to the National Museum in Washington. This labour occupied him for about three years. The results of his work have been given to the public in various forms. A full account of the topography, with an elaborate map, appeared in Petermann's *Mittheilungen*, and a paper on the ethnology of the native tribes, published by the American Philosophical Society, is one of standard value.

In the autumn of 1876 he revisited San Domingo, returning to the United States in March last. For many years he has been threatened with pulmonary disease, the extension of which has been checked by his abode in subtropical regions. The unfavourable symptoms, however, increased of late, and he succumbed shortly after his return to Philadelphia.

Dr. Gabb left an extensive manuscript on the geology and palæontology of Costa Rica, which will be published ere long under competent supervision, thus closing a career of energy and activity, not only in the prosecution of researches, but in the elaboration of their results, which has been seldom equalled by a man of his age. It is very rare, indeed, that one man has accomplished so much in so many distinct branches—in geology, geography, palæontology, ethnology, &c.—as the subject of our present notice.

ON THE ANATOMY OF THE ORGAN OF HEARING IN RELATION TO THE DISCOVERY OF THE PRINCIPLE OF THE MICROPHONE OF PROF. D. E. HUGHES, AND THE MAGNOPHONE OF MR. W. L. SCOTT, A.S.T.E.[1]

THE two gentlemen whose names appear in the heading of this paper seem to have arrived at the same important result, viz., the extraordinary effect of mobile particles in transmitting sound under certain conditions, by quite independent research. In perusing the interesting accounts of the *microphone* in several scientific journals, but especially an article in the *Electrician* for May 25, in which number also will be found Mr. Scott's statement of the principle, it occurred to me that the transmitting power of the *otoconia* and *otoliths* in the ears of animals bore very pertinently upon this question. We find *otoconia*, or numerous minute particles in all the *Vertebrata*, with perhaps the exception of the bony fishes which have single concretions, or the union of many in one. *Otoconia* are also found in the *Tetrabranchiate Cephalopoda* (*Nautilus*, Fig. 1), the whole of the *Pteropoda*, in the *Pulmonifera inoperculata*, or rather the bisexual *Pulmonifera* (snails and slugs, Fig. 3), there being an operculum in *Amphibola*. On the other hand, in the *Dibranchiate Cephalopoda* (*Sepia*, Fig. 2), all the *Heteropoda* (Fig. 5) and the *unisexual operculate Pulmonifera* (Fig. 4) the ear-sacs contain single *otoliths*.

It will be thus seen that the nature of the auditory concretions is by no means an unimportant element in the classification of animals.[2] Prof. Huxley alludes to the genus *Polyophthalmus*, an Annelidan with eyes in every segment, as a remarkable fact, but this is excelled by his notice of otoliths in the tail of *Mysis flexuosa*,[3] a little pelagic crustacean which I have often had the opportunity of examining.

Every physiologist is aware that there are structural particulars in the ears of *Vertebrata* which show clearly that nature's philosophy is of a more profound character than that to which man has hitherto attained. Indeed if we study the simplest ears in creation, those, for example, of the common *Snail* and of the *Periwinkle*, a most interesting problem is presented to us to solve, namely, the precise function of the numerous otoconia in one case, and of the single otoliths in the other. It is commonly granted that these concretions augment the sonorous undulations by resonance, a view which is borne out by several considerations. If we take two stones and strike them together under water, the head also being immersed, the collision will produce a very loud and peculiar sound, but in order to make the minute otoconia impress one another

[1] By John Denis Macdonald, M.D., F.R.S., Dep. Ins. Gen. R.N., &c.

[2] See a paper by the author in the *Linnean Transactions* for 1860, in which a classification of the Gasteropoda has been attempted.

[3] See *Ann. and Mag. of Nat. Hist.* for May, 1851.